Solutions: H.W. CH. # 1; Fall Semester 2001 (011)

5. Given: $R = 6.37 \times 10^{6}$ m ; Assume Earth is sphere

Its circumference in kilometers

Circumference $= 2\pi R = 2\pi (6.37 \times 10^{6} \text{ m})\left(\frac{1 \text{ km}}{10^{3} \text{ m}}\right) = 40.04 \times 10^{3}$ km

We have to get the answer in 3 significant figures:

$\underline{\underline{4.00 \times 10^{4} \text{ km}}}$

b) Surface Area $= 4\pi R^{2} = 4\pi \left(6.37 \times 10^{6} \text{ m}\right)^{2} \left(\frac{1 \text{ km}}{10^{3} \text{ m}}\right)^{2}$

$4\pi \times (6.37)^{2} \times 10^{6} \text{ km}^{2} = \underline{\underline{5.10 \times 10^{8} \text{ km}^{2}}}$

c) Volume $= \frac{4}{3}\pi R^{3} = \frac{4\pi}{3} \left(6.37 \times 10^{6} \text{ m}\right)^{3} \left(\frac{1 \text{ km}}{10^{3} \text{ m}}\right)^{3}$

$= \frac{4}{3}\pi \times (6.37)^{3} \times 10^{9} \text{ km}^{3} = \underline{\underline{1.08 \times 10^{12} \text{ km}^{3}}}$

7. Given: $R = 2000$ km

Volume of ice in cm^{3}?

$V = \text{Area} \times \text{thickness} = \frac{1}{2}(\pi R^{2}) \times t$

$= \frac{1}{2}\pi (2000 \text{ km})^{2} \left(\frac{10^{3} \text{ m}}{1 \text{ km}}\right)^{2} \left(\frac{10^{2} \text{ cm}}{1 \text{ m}}\right)^{2} \times (3000 \text{ m})\left(\frac{10^{2} \text{ cm}}{1 \text{ m}}\right)$

$\frac{1}{2}\pi (2000)^{2} \times 10^{6} \times 10^{4} \text{ cm}^{2} \times 3000 \times 10 \text{ cm} = 18.857 \times 10^{21} \text{ cm}^{3}$

$= \underline{\underline{1.9 \times 10^{22} \text{ cm}^{3}}}$

11. Conversion: $1 \text{ m} = 3.281 \text{ ft}$, $1 \text{ s} = 10^{9} \text{ ns}$; $1 \text{ m} = 10^{3} \text{ mm}$, $1 \text{ s} = 10^{12} \text{ ps}$

$3 \times 10^{8} \text{ m/s} = \left(3 \times 10^{8} \text{ m/s}\right)\left(\frac{3.281 \text{ ft}}{1 \text{ m}}\right)\left(\frac{1 \text{ s}}{10^{9} \text{ ns}}\right) = 0.98 \text{ ft/ns}$

$3 \times 10^{8} \text{ m/s} = \left(3 \times 10^{8} \text{ m/s}\right)\left(\frac{10^{3} \text{ mm}}{1 \text{ m}}\right)\left(\frac{1 \text{ s}}{10^{12} \text{ ps}}\right) = 0.30 \text{ mm/ps}$

Given: Density of Gold = $19.32\ g/cm^3$ $\quad (M = \rho V)$

a) Volume of 27.63 g of gold $= \left(\frac{1\ cm^3}{19.32\ g}\right)(27.63\ g) = 1.430\ cm^3$

V = Area * thickness $= A * t$

$$\text{Area} = \frac{V}{t} = (1.430\ cm^3)\left(\frac{1}{10^{-6}\ m}\right)\left(\frac{1\ m}{10^{2}\ cm}\right) = \frac{0.0143}{10^{-6}}\ cm^2$$

$$A = 14300\ cm^2 = 1.430 * 10^{4}\ cm^2$$

b) Volume of a cylinder $= \pi R^2 L \Rightarrow L = \frac{V}{\pi R^2}$

$$L = (1.430\ cm^3)\left(\frac{1}{\pi * (2.500 * 10^{-6}\ m)^2 * \left(\frac{10^2\ cm}{1\ m}\right)^2}\right) = 0.0728 * 10^{8}\ cm$$

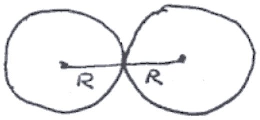
$$L = 7.280 * 10^{6}\ cm$$

23: Given: $\rho_{iron} = 7.87\ g/cm^3 = \left(7.87\ \frac{g}{cm^3}\right)\left(\frac{1\ kg}{10^3\ g}\right)\left(\frac{10^2\ cm}{1\ m}\right)^3$

$M_{iron\ atom} = 9.27 * 10^{-26}\ kg$

a) $$V_{iron\ atom} = \frac{M_{iron\ atom}}{\rho_{iron}} = \frac{9.27 * 10^{-26}\ kg}{7.87 * 10^{3}\ kg/m^3} = 1.18 * 10^{-29}\ m^3$$

The distance between the centers of adjacent atoms is equal to twice the radius, i.e. $2R$ and R can be found from the relation



$S = 2R$

$$V_{atom} = \frac{4}{3}\pi (R_{atom})^3 \Rightarrow R_{atom} = \left(\frac{3 V_{atom}}{4\pi}\right)^{1/3}$$

$$= \left(\frac{3 * 1.18 * 10^{-29}\ m^3}{4\pi}\right)^{1/3} = 0.141 * 10^{-9}\ m$$

$$S = 2R = 2.82 * 10^{-10}\ m = 0.282 * 10^{-9}\ m = 0.282\ nm$$